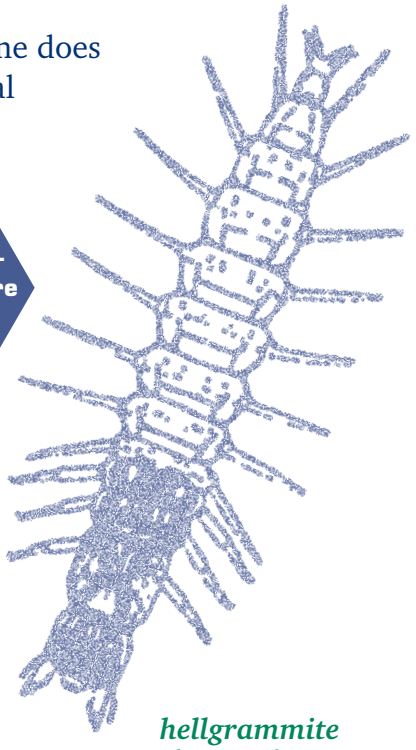
What do scientists measure?

Temperature - When you don't feel well, chances are the first thing someone does is take your temperature. Scientists measure water temperature for several reasons. First, it determines the kinds of animals that can survive in a stream. If the temperature gets too hot or too cold for some organisms, they die. Temperature also can affect the chemistry of the water. For example, warm water holds less oxygen than cold water. A healthy cluster of trees and vegetation next to a stream or river helps keep temperatures cool for trout and other fish.

! The words highlighted in bold are defined in the glossary.



hellgrammite (larva of a dobsonfly)

Dissolved oxygen - Scientists measure **dissolved oxygen**, or DO (pronounced dee-oh). This tells them how much oxygen is available in the water for fish and other aquatic organisms to breathe. Healthy waters generally have high levels of DO (some areas, like swamps, naturally have low levels of DO). Just like human beings, aquatic life needs oxygen to survive. Several factors can affect how much DO is in the water. These include temperature, the amount and speed of flowing water, the plants and algae that produce oxygen during the day and take it back in at night, pollution in the water, and the composition of the stream bottom. (Gravelly or rocky bottoms stir up the water more than muddy ones do, creating bubbles that put more oxygen into the water.)

pH - Scientists measure **pH** to determine the concentration of hydrogen in the water (The p stands for "potential of" and the H is hydrogen.) pH ranges from 0 (very acidic) to 14 (very basic), with 7 being neutral. Most waters range from 6.5 to 8.5. Changes in pH can affect how chemicals dissolve in the water and whether organisms are affected by them. High acidity can be deadly to fish and other aquatic organisms.

Nutrients - Just as **nutrients** are critical for you to grow (check out what's inside a box of cereal—essential nutrients), they are critical to plants and animals. The two major nutrients scientists measure are **nitrogen** and **phosphorus**. The presence of too many nutrients can hurt aquatic organisms by causing lots of algae to grow in the water. Nutrients can also affect pH, water clarity and temperature, and cause water to smell and look bad.

Aren't nutrients good for you?

Just like anything in life, moderation is the key (consider television). Although every living thing needs nutrients to grow, too many nutrients in the water cause algae to grow out of control. At night, they suck all of the oxygen out of the water so the fish and other organisms can't breathe. Also, when algae die, they are decomposed by oxygen-breathing bacteria that pull DO out of the water.

Toxic substances - Scientists also test for many harmful (toxic) things like metals, pesticides, and oil. For example, scientists are finding mercury in certain types of fish, especially in lakes and estuaries. Mercury comes from mining, natural sources and air pollution from power plants and incinerators. People are warned not to fish if mercury or other harmful substances are a problem in a stream, lake or bay.

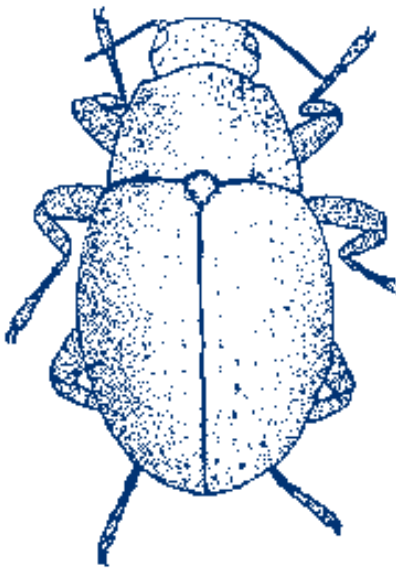
Turbidity - Scientists measure the **clarity** of water to determine how many particulates (little bitty particles of stuff) are floating around. If you're sitting on a

dock in a pond on a warm summer day, you might be able to see to the bottom. That's low turbidity. On the other hand, if you visit the dock after a rainstorm when all the muck has been stirred up, you won't be able to see the bottom; that's high turbidity. Scientists use **turbidity** measurements to calculate the inputs from erosion and nutrients.

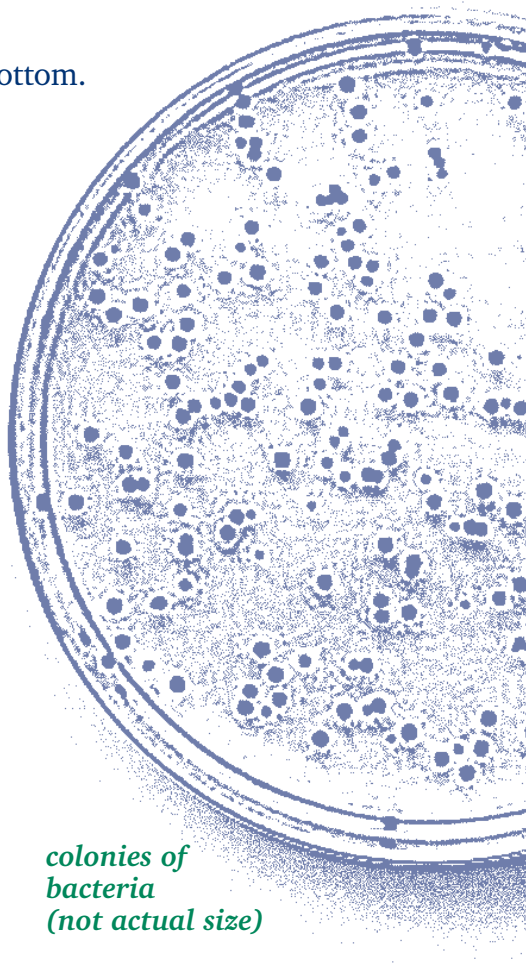
Bacteria - Scientists sample for certain types of bacteria that are found only in the stomachs and intestines of warm-blooded animals and humans. These bacteria are not necessarily harmful, but they usually hang out with some bad characters like viruses and germs that can make you sick. Scientists test for bacteria that indicate that those more dangerous organisms might be in the water.

Visual surveys - Not all measurements are chemical or physical. Scientists take measurements of the landscape surrounding a stream to determine things like the amount of trees and shrubs along a stream, the amount of shade that is created by trees overhanging the stream, and woody debris (sticks and leaves) in the stream. The more vegetation, tree cover, and woody debris, the more habitat is created for wildlife and fish. Vegetation can even trap pollutants before they enter the stream. Tree cover also helps regulate water temperature, which is important to trout and other fish that need cold water to survive.

Biological sampling - Scientists determine the health of waters by taking samples of fish, plants and smaller organisms called **macroinvertebrates** (mack-row-in-ver-tuh-brets). Macroinvertebrates include things like snails, worms, fly larvae, and crayfish ("crawdads"). You find them under rocks and tree roots in the water. These critters tell a story about the health of the stream. Some of them love to live in water that's dirty, so if scientists find a lot of those in a sample, they know there's a problem. Other organisms can survive only in water that's very clean, so finding those means the water is probably healthy.



riffle beetle—
found in clean water



colonies of
bacteria
(not actual size)

Raise your hand if you live in a watershed

Is your hand up? Good. Everyone lives in a watershed. A watershed is simply an area of land that drains the rainwater (or snow) into one location such as a stream, lake, or wetland. This means that the runoff from streets, fields, and lawns will eventually drain into those streams, lakes, or wetlands. Cup your hands as if you are going to drink water from a faucet. Your thumbs and fore fingers are like the ridges of a watershed and your palms are like the waterbody that catches the rainwater. Watersheds can vary in size and shape from a couple of square miles to hundreds of thousands of miles. We all live, work, and play in watersheds, and what we do affects everything and everyone else in the watershed.

How many uses for water can you think of?

Make a list of how water is used by people, plants and animals. Here are a few ideas:

- **drinking**
- **swimmimg**

- **showering**
- **watering the lawn**
- **homes for fish, bugs and wildlife**
- **irrigating crops**
- **navigation**

Scientists group these uses into a few overall categories, like Aquatic Life, Drinking Water, and Recreation. They then decide what categories of uses a waterbody *should* support (for example, virtually all waterbodies should support aquatic life), and monitor the waterbody to see if it supports its uses.

How is the quality of our waters determined?

Every state adopts goals or standards that need to be met for its waters, based on the intended uses of the waterbodies. Different goals are set for different waterbody uses. For example, if the water is going to be used for cooling machinery in a factory, it doesn't have to be as clean as water used for drinking. Scientists monitor the waters and give them one of the following scores:

(GOOD) The waterbody fully supports its intended uses

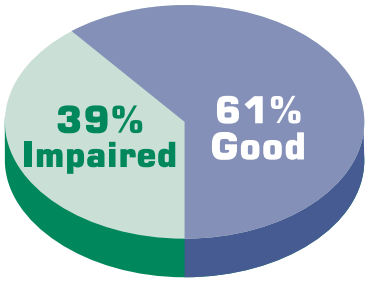
(IMPAIRED) The waterbody does not support one or more of its intended uses

What is the quality of our waters?

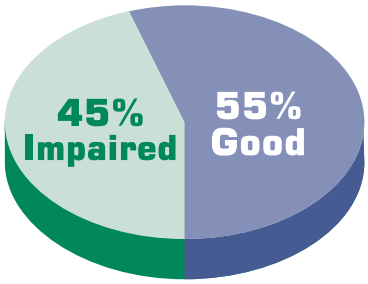
Surface waters are waters that you can see. These waters include rivers and streams, lakes, ponds, reservoirs, **wetlands**, coastal waters, and **estuaries**.

For the U.S. waterbodies sampled most recently, about 45% are rated as impaired. The charts here show, by the type of waterbody, what percentage of the assessed waters were rated GOOD and what percentage were rated IMPAIRED.

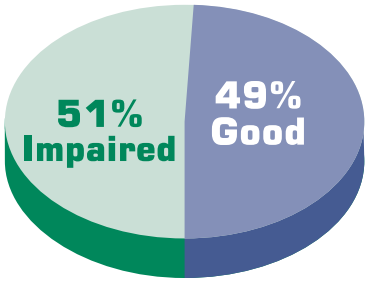
Assessed River and Stream Miles



Assessed Lake, Pond, and Reservoir Acres



Assessed Estuary Square Miles



What percentage of all waterbodies are assessed?

We don't have the money or technology to sample all the waterbodies in the U.S. The nation has more than 3,600,000 miles of rivers and streams alone! If all the rivers and streams were placed end-to-end, they could wrap around the earth 144 times. Each state assesses only a portion of its waters. Here are the latest numbers we have for percentage of U.S. waters assessed:

19% of rivers and streams
43% of lakes, ponds, and reservoirs
36% of estuaries
6% of ocean shorelines
92% of Great Lakes shoreline